

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554**

|                               |   |                     |
|-------------------------------|---|---------------------|
| In the Matter of              | ) |                     |
|                               | ) |                     |
| Telephone Service for Indians | ) | BO Docket No. 99-11 |
| On Reservations               | ) | DA 99-430           |

**COMMENTS OF MOTOROLA**

Motorola is pleased to submit these comments as part of the FCC's ongoing series entitled "Overcoming Obstacles to Telephone Service for Indians on Reservations."

Attached are several presentations discussing different technology solutions, including mobile satellite technology provided by Iridium North America, that may be appropriate for addressing some of the needs of Native Americans. We also discuss the obstacles to deploying those technologies.

We believe that better access to telecommunication can facilitate education, health care intervention, and labor force participation for Native Americans. Technology solutions, however, must recognize the rich heritage and culture of Native Americans. Further dialogue is needed to better educate manufacturers and service providers on how technology might affect their cultural heritage.

As with all population groups, no single technology solution will satisfy all needs. Thus, we present here several different communications solutions, each of which address different communications needs. In our view, competition and diversity of communications options will best serve the needs of the Native American communities as well as all Americans.

Respectfully Submitted,

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## **TWO WAY WIRELESS COMMUNICATIONS SOLUTIONS FOR NATIVE AMERICANS**

Tribal governments across our nation use two-way mobile radio to meet their needs for emergency medical services and public safety operations. This section will briefly address the systems available, their operation and the issues involved in obtaining this service.

### **EMERGENCY MEDICAL SERVICES**

Tribal ambulance services typically mirror those of any community. They must receive dispatch requests during emergencies as part of their tribal responsibilities as well as be able to communicate with state, local and federal agencies when the need arises. Ambulance dispatch can often cover large areas of operation and therefore require high power, multi-frequency equipment. Specialized wireless equipment is often needed to provide front and rear control of the radio, headset operation and intercom support.

Native American hospitals, clinics and other medical facilities often use two-way radio for dispatch of hospital personnel. They use private paging systems to support personnel on call and to dispatch code blue emergencies. Most emergency operations must maintain communications with the ambulance fleet and be able to tie into mutual aid operations or civil defense activities during disasters.

### **PUBLIC SAFETY**

Tribal police and security personnel equip their patrol cars with two-way radio to keep them in communication for protection of life and property. In addition to their tribal

lands and laws they are constantly in need of maintaining contact with state, local and federal agencies. Many casino operations rely on radio to support their security efforts. In the areas where the tribal government has its own fire protection, it will require specialized equipment for fire trucks and fire fighting personnel. They must also be able to communicate with other local jurisdictions for mutual aid.

## **SYSTEMS**

Typical two-way radio systems can be as basic as a single site base station to support the users' areas of operation to very complex multi-site trunking systems. Each requires design consideration based on input from the user group and the system supplier to meet the operational needs. Suitable transmitter sites, frequency choices, and equipment features must all be taken into consideration in providing the proper solution. Emergency medical and public safety systems often require in-depth engineering studies to determine the proper balance of radio system elements to meet the objective of the user.

## **ISSUES**

Tribal governments face many obstacles in obtaining two-way radio solutions. They are eligible for frequencies in several radio services, yet they have no direct voice in any of them. They can be assigned state and local government frequencies, federal government frequencies or even business band frequencies. Many times, they are forced to use frequencies that do not really support their need or objective. They also must now

deal with migrating to narrowband technologies, which complicates migration and interoperability obligations.

The tribal governments must interoperate with state, local and federal agencies, so they typically try to design their radio communications systems to provide this capability. Due to frequency assignment constraints, it is often difficult to do so. Ambulances need to be in-band with the agencies they look to for support in the surrounding communities. Hospitals need frequencies to keep their facilities running and paging channels to support emergencies. Public safety officials need to know they have frequencies to conduct their activities on that are not shared with non-public safety users.

The single largest issue facing the tribal governments is, however, funding. That the present administration has placed emphasis on improving the public safety environment for Native Americans can have a very positive impact. As funding levels increase, the FCC should ensure that regulatory obstacles such as spectrum acquisition do not become bottlenecks to these users gaining access to telecom services.

## **WIRELESS LOCAL LOOP SOLUTIONS FOR NATIVE AMERICANS<sup>1</sup>**

This section intends to describe how Wireless Local Loop (WLL) technology and regulatory liberalization benefits both operators and end users in rural and depressed markets. This section focuses on the following three major topics as shown on Slide 1 of the attached presentation:

- WLL worldwide
- Requirements and Solutions
- Observations for the United States and Territories

Though much of this presentation focuses on WLL generally and the worldwide drivers for WLL technologies, we do address rural and depressed markets specifically near the end of this section.

Motorola is a provider of WLL solutions. Historically, the solutions have been based on cellular technologies. For approximately the last six years, Motorola's Wireless Access Systems Division (WASD) has been promoting a cdmaOne™ solution named "WiLL®".

The map on Slide 2 illustrates the countries where WLL activity has been observed. To date, seventy (70) countries have been identified. Subtracting the number of wirelines and wireless access lines from the number of locations (residences and businesses) enables us to forecast the number of unserved locations. This is key to understanding the huge potential market, and the need for regulatory liberalization in order to meet end-user demand.

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<sup>1</sup> Slides associated with this discussion are attached to this presentation.

The map on Slide 3 depicts the countries where WiLL® participates, both in Analog and cdmaOne technologies.

This paper also aims to identify requirements and solutions for WLL deployment. Slide 4 shows the topics to be covered; namely: the User/Application segments, popular WLL technologies, and the advantages of cdmaOne™ technology. This section highlights throughout how deregulation and privatization is a key factor in enabling a business case for WLL.

There are three end-user segments and one application in the WLL industry. These segments are listed on Slide 5 as:

1. Basic Voice (B.V.S.) segment
2. High End Residential (H.E.R.) segment
3. Commercial/Small-Medium Enterprise (S.M.E.) segment
4. Pay Phone and Public Calling Office application

It is important to note that each of the segments has key service differentiators:

- The Basic Voice (B.V.S.) segment is characteristic of the original WLL concept. These end-users have "POTS" (**P**lain **O**ld **T**elephone **S**ervice) requirements, are extremely price sensitive, and are primarily first-time users. This segment is often representative of Universal Service regulatory targets.
- The High End Residential (H.E.R.) segment can be categorized as early adopters. They have "POTS" requirements, but also seek enhanced services such as caller ID and voice mail. These end-users tend to be affluent and middle-class consumers. This segment also has a high penetration of mobile phones.
- The Commercial/SME (S.M.E.) segment is very high-performance oriented. They have "POTS and PANS" (**P**retty **A**maz**I**ng **N**ew **S**tuff) requirements, desiring PBX features, plus fax and high-speed data. This segment is the prime target of fixed wireless CLECs. As such, the growth of the S.M.E. segment is linked to regulatory liberalization.
- Pay Phone and Public Calling Office application is a niche application. It is an operator revenue concept. A specialized application and feature, it is a shared resource among the poor.

In the WLL market, there are vast differences between end-user segments in *"developed"* and *"developing"* countries. These differences can be correlated to operator motivation. Slide 6 captures the motivation that impacts the two operator segments. The two operator segments are Competitive Local Exchange Carriers (CLECS) and the Post, Telephone & Telecommunications agencies (PTT).

Developed countries are seeing the presence of Competitive Local Exchange Carriers (CLECS). The Competitive Local Exchange Carrier segment can be characterized by their aggressive attitudes towards business and growth, their presence in multiple markets, and their reliance on business cases analysis for decision-making for system investments. These entities evolved from cellular system operators, so they tend to compare WLL opportunities to their experience as mobile suppliers, anticipating fast growth, good margins and cellular telephone/retail distribution models. CLECs are motivated by "the best business case."

The operators in developing countries are primarily the Post, Telephone & Telecommunications agencies (PTT). This segment can be characterized by government ownership, entrenched positions as suppliers of landline and mobile communications service, and access to existing cash flows. As extensions of a government, they sometimes can influence regulations and requirements on spectrum, and often operate on the basis of societal benefit. Their motivation is to increase teledensity and meet universal service targets.

The graph on the left-hand side of Slide 6 represents the anticipated mix of fixed subscriber equipment deployments over a five-year period, by environment (Urban, Suburban, Rural). In developed countries, the majority of subscriber opportunities are in

densely populated areas (urban and suburban) where approximately 91% of the subscriber opportunities will be located. Contrarily, in developing countries, subscribers should be evenly distributed among urban, suburban and rural environments.

The graph on the right-hand side of slide 6 further illustrates operator motivation by identifying the difference in the anticipated end-user segment to be served. In developed countries, 70% of the end users are expected to be SME's, who are very high-performance oriented and should be the prime target of CLECs. In developing countries, the largest end-user segment is anticipated to be in Basic Voice Services (B.V.S.). This segment is extremely price sensitive, primarily first time users, and often the target of Universal Service mandates.

Slide 7 depicts the expected distribution of WLL deployments over the five-year period. The darker-shaded areas reflect the opportunities that are most favorable to the operator's business case. In developed countries, the largest percentage (28%) of the industry subscriber total is in environments and segments that can command the most profit. In developing countries, there is a much higher spread across more environments and segments.

WLL services are generally categorized as Data (Internet, file transfers), Fax and Voice. Slide 8 identifies the demand for these services as an anticipated percentage of total traffic. In the B.V.S. segment, 94% of traffic is for voice. In the H.E.R. segment, 80% is for voice, with the balance evenly distributed between data and fax. In the S. M. E. segment, traffic is evenly distributed between voice and non-voiced services, with non-voice services evenly split between data and fax.

Slide 9 references the three dominant terrestrial WLL technologies: (1) Cordless, such as DECT, PHS, PACS, etc., (2) Fixed Wireless Access, and (3) Cellular. Fixed Wireless Access includes everything that was designed to provide the wireless link. It is not capable of mobile service. Cellular includes technologies such as TDMA, Analog, GSM and cdmaOne.

Slide 10 notes DECT, PHS and PACS, (U. S. version of PHS) as the primary cordless technologies. Motorola was involved in the early stages of PACS development. Although the United States has allocated the unlicensed PCS band of 1910 - 1930MHz, Cordless is not used or being pursued for WLL in the United States.

However, other countries are using this band for DECT deployments. This mature, digitally based technology is moderately priced, offers a wide range of suppliers and provides mobility. Its small cell footprints, high annual operating and maintenance costs, and the fact that interoperability among vendors is not guaranteed has meant that operators are ambivalent about this technology.

Fixed Wireless Access (FWA) evolved from Microwave and cellular-based technologies. As noted on Slide 11, FWA WLL solutions operate between the 2 - 28 GHz band, and are primarily proprietary, point-to-point, and point-to-multipoint. This solution offers high capacity for data and relatively fast data speeds, good voice quality and wireline transparency /PBX features such as caller I.D. and voicemail. A few CLECs in urban markets in the United States are targeting high-end commercial segments, such as banks and professional services. Due to operator cost impacts, such as expensive subscriber equipment, reliance on external, line-of-sight antennas, lack of vendor

interoperability, interface standards, and small cell footprints, the business case is favorable only in environments with high-end user teledensity.

Slide 12 shows that cellular WLL solution actually evolved from first generation cellular technologies. Cellular WLL solutions operate in the 800MHz, 900MHz, 1800MHz or 1900MHz bands. The most popular of the Cellular WLL solutions are Time Division Multiple Access (TDMA) and code Division Multiple Access (CDMA) and also include second generation technologies such as cdmaOne™, GSM, and iDEN. This mature, digital technology with highly scaleable capacity, coverage and features, enables network operators to incrementally add more cells as the subscriber base increases, and offers subscribers a choice of adding more features as they become more sophisticated. Cellular WLL solutions have a large footprint coverage for rural markets (one cell covers a wide area), vendor interoperability (can "shop" among vendors for the best value) and low annual operating and maintenance per unit. Data speeds, however, lag behind fixed wireless access technologies, and wireline transparency features vary between vendors. In the United States, cellular operators are conducting trials with residential segments using WLL. These carriers are mostly CLECs, and view WLL as a way of competing with the incumbents for fixed services.

Slide 13 details the reasons why Motorola's WASD prefers cdmaOne™ for its WiLL® technology:

- √ A wide range of compliant equipment vendors allows for ***interoperability*** (Operators can "shop" among vendors for the best value.)
- √ ***Scaleability*** in cost, capacity and coverage (Lower operator start-up costs. Operators do not buy more than they need, and they can incrementally add more cells as their subscriber base increases.)

- √ cdmaOne™ technology is noted for its excellent *voice quality*  
(Increases end-user satisfaction.)
- √ cdmaOne™ technology *enables highly desired end-user services and calling features* such as privacy and encryption, caller ID, voice mail.  
(End-users can add more features as needed. Increases end-user satisfaction.)
- √ A *roadmap* to enhanced performance both in data speeds and capacity  
(End-users receive faster data speeds and operators can optimize the network.  
Increases end-user satisfaction and operator profitability.)

Motorola cdmaOne™ WiLL® systems operate in the 800MHz and 1900 MHz bands on either fixed, mobile or hybrid (fixed and "limited" mobile) systems. Slide 14 contains an architectural diagram of a cdmaOne™ system. An integral part of a network is the switch. Some of the functions of the switch interface are to provide the fax, data, and high capacity capability. The diagram depicts a hybrid system using our more popular V5.2 switch interface architecture. The V5.2 switch is designed to optimize a fixed system. When using mobile handsets, consumers can achieve "limited mobility."

Terrain and traffic requirements are not the same in every country. As can be seen on Slide 15, Motorola has a broad CDMA base station product line. Offering operators a choice of base stations allows them to optimize the fit of infrastructure to their environment.

Motorola uses the term "Fixed Wireless Terminal (FWT)" for end-user or subscriber equipment. Slide 16 speaks to why FWT versatility is a benefit to both the operator and end-user. Versatility equals "choice." The "*local or 100m remote*" capability offers the end-user a choice as to where to locate the telephone up to 100m away from the FWT. The option of being able to select either an omni-directional or

directional antenna gives the operator a choice of either rapid deployment or increased coverage and capacity.

An omni-directional antenna is easy to install and spares the operator the costly installation and maintenance charges incurred when an antenna is affixed to the outside of a building. When choosing an omni-directional antenna, an operator can rapidly deploy the system (quicker return on investment) and reap the benefits of a lower cost of ownership. In terrain where coverage is a challenge, a directional antenna is a powerful solution. Directional antennas decrease the power of an FWT, and increases capacity on the network. Directional antennas can decrease the number of cell sites in a network. Most networks utilize a mix of 80% omni-directional and 20% directional antennas. The ability to "*mix and match*", based on environment, enables the operator to provide the best service in the most cost-efficient manner.

To further illustrate this point, Slide 17 provides a side-by-side comparison of omni-directional to directional antennas. Omni-directional antennas are advantageous both in cost and distribution factors. CLECs, who primarily evolve from cellular system operators and compare WLL opportunities to their experience as mobile suppliers, find the use of omni-directional antennas attractive from a business case perspective.

Slide 18 compares Macrocell (large cell) WLL to Microcell WLL. With Macrocell there is minimal use of directional antennas, and lower monthly site rental and backhaul costs. Use of Macrocell WLL, particularly in areas with low density, improves an operator's business case.

cdmaOne™ technology uses the Enhanced Variable Rate Coder (EVRC) to digitize the voice input so that it can be sent efficiently over the bandwidth constrained

RF channel. Slide 19 graphs the mean opinion score in comparison tests under a variety of conditions. In a *Clean Speech* environment, there is no marked difference in levels. When interference is introduced (*Babble, Car, Street*) EVRC always scores the highest level. cdmaOne™ is noted throughout the wireless industry for voice quality. EVRC is a contributing factor.

To further demonstrate, Slide 20 illustrates how Path Diversity is another factor contributing to the excellent voice quality of cdmaOne™. This example compares TDMA technology with CDMA. Built into every FWT in cdmaOne™ technology is what is called a "Rake" receiver. The rake receiver is actually multiple receivers or "paths." The system carries the voice message on "frames." Each half-second word is split into multiple frames. When a signal is transmitted there is often fading. Using a rake receiver, the system can simultaneously receive multiple signals on every frame that passes, choosing to pass on only the **best** signal. The effects of fading are mitigated. With cdmaOne™ technology, only the **best possible audio** reaches the listener.

As noted on slide 21, observations have revealed that there are barriers and enablers for the successful deployment of WLL in rural and depressed markets within the United States. Slide 22 addresses the barriers.

The United States wireless marketplace is comprised of a large number of mobile cellular phone operators. It is a highly competitive environment. These operators are mostly CLECs, driven by profit. They are pursuing the business case that offers the highest margins. The environment they seek is one with a high potential end-user density (a large number of homes/business per square kilometer). They are all competing for the high premium segments whose requirements for value-added services and enhanced

performance will grow. Unlike the PTT, who often operate on the basis of societal benefit, CLECs are concerned with disposable income and other financial considerations related to the end-user segments.

These barriers to deployment of WLL technologies for rural and depressed markets in the US means that certain conditions to promote deployment will be required. The conditions are addressed on Slide 23 along with some recommendations that will enable telephony service to end-users in rural and depressed markets.

Cellular technologies currently cover most of the U. S. and its territories. cdmaOne™ WiLL® systems can operate on these mobile cellular systems. These networks are primarily operated by CLECs. The ability to offer WLL telephony to end-users located in rural and depressed markets in the United States requires that this market become more attractive to CLECs from a business-case standpoint.

- Providing financial incentives that stimulate operator interest in rural/depressed markets is an enabler. Incentives can be in the form of rebates on spectrum auction fees, or "no cost" WLL spectrum. An example would be to have a drawing for "free" spectrum. A stipulation to the operator is that this "free" spectrum, or a specified portion, must be used for WLL for providing service to the target market. Other incentives can be in the form of tax credits or grants for costs associated with servicing the target population, or equipment and/or service cost subsidies for qualified users. An example of this is where the government buys the phones and gives them to the operator. The government selects the population who will receive the free phones.
- Universal Service mandates specifying WLL penetration and schedules on new spectrum allocations is another method of facilitating deployment of WLL telephony to rural and depressed areas. For instance, regardless of how the operator received the spectrum, the government could mandate goals that a certain percentage of end-users within the target population must receive WLL service. Attaining penetration goals could also be accomplished by offering free phones. End-users who receive free phones could be tracked by the government and their names given to the operator with a goal of installation within a specified period of time.

WLL telephony service for end users in rural and depressed populations **is achievable**. To achieve this goal, providing service to the end-user target population must be attractive to the operator from a business case perspective. Regulatory liberalization will benefit both operators and end users and result in a win/win situation

# WIRELESS LOCAL LOOP SOLUTIONS FOR NATIVE AMERICANS: SLIDES

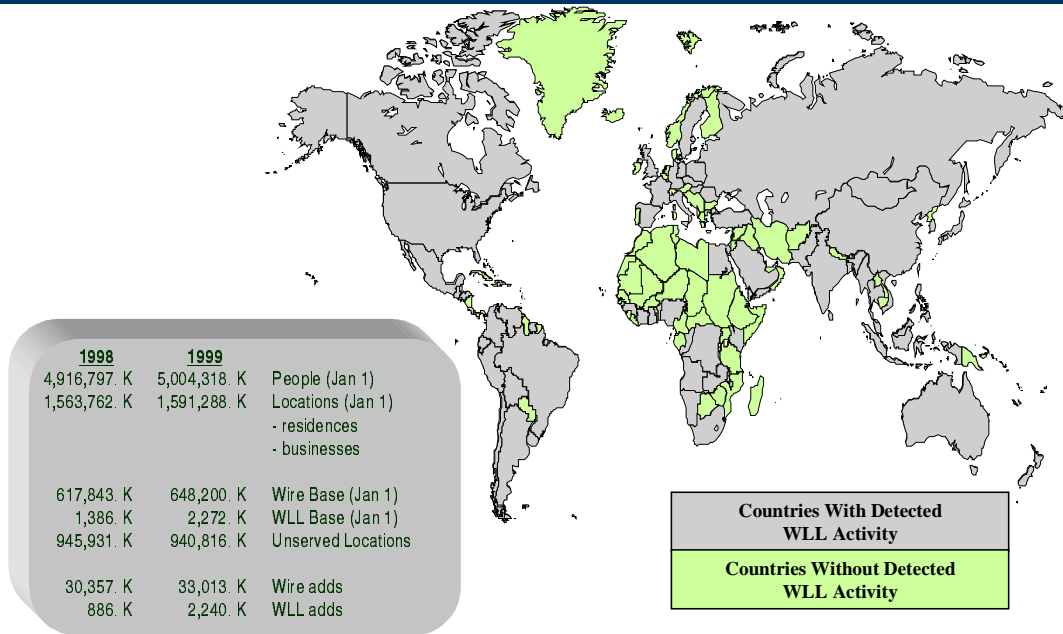
## WASD Agenda

- WASD
  - Motorola Provider of WLL Solutions
  - Promoting “WiLL®” for at least 6 years
  - Historically pursued cellular based WLL solutions
- Worldwide WLL Background (5m)
  - Market Size
  - Motorola’s Involvement via “WiLL®”
- Requirements & Solutions (20m)
  - User/Application Segments
  - Popular WLL Technologies
  - Advantages of cdmaOne™ for WiLL®
- Observations for US/Territories (5m)
  - Barriers
  - Enablers

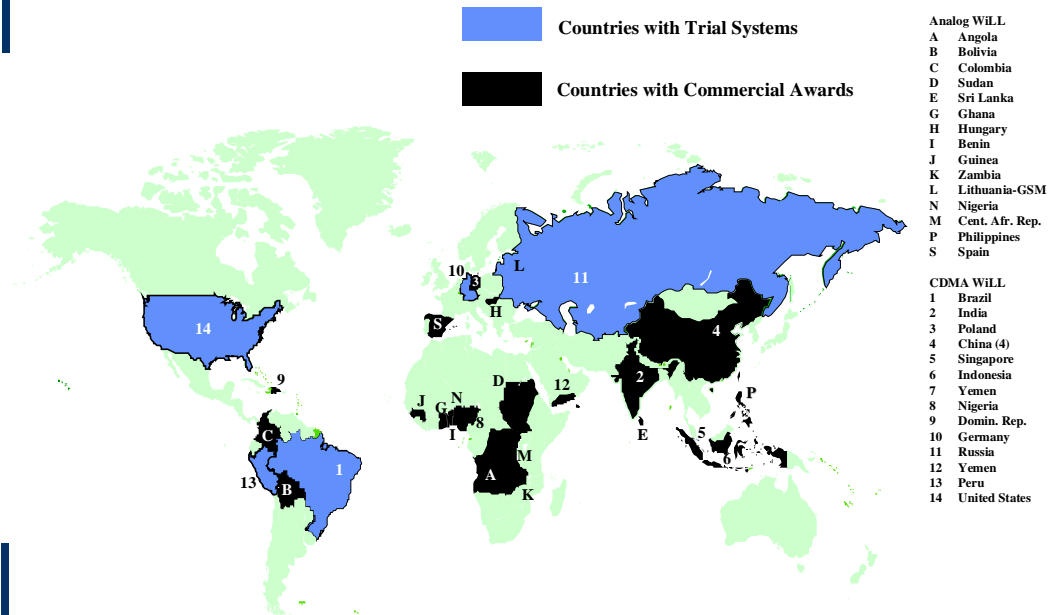


MOTOROLA

# Opportunity Forecast (70 Countries With Detected WLL Activity)



# Motorola WAsD's WiLL® System Deployments, Awards & Trials



# WASD Agenda

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  - Motorola Provider of WLL Solutions
  - Promoting “WiLL®” for 6 years
  - Historically pursued cellular based WLL solutions
- Worldwide WLL Background (5m)
  - Market Size
  - Motorola’s Involvement via “WiLL®”
- Requirements & Solutions (20m)
  - **User/Application Segments**
  - **Popular WLL Technologies**
  - **Advantages of cdmaOne™ for WiLL®**
- Observations for US/Territories (5m)
  - Barriers
  - Enablers



## Three End-User Segments + One Application

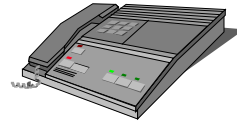
### Basic Voice

- original WLL concepts
- "POTS" requirements
- extremely price sensitive
- primarily 1st time users
- Universal Service regulatory target



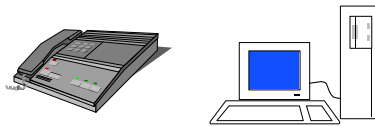
### High End Residential

- early adopters
- "POTS +" requirements (Caller ID, V-mail, etc.)
- affluent & middle class consumers
- high penetration of mobile phones



### Commercial/SME

- high performance oriented
- "POTS & PANS" requirements
- PBX features + fax, high-speed data, etc.
- growth linked to regulatory liberalization
- prime target of fixed wireless CLECs

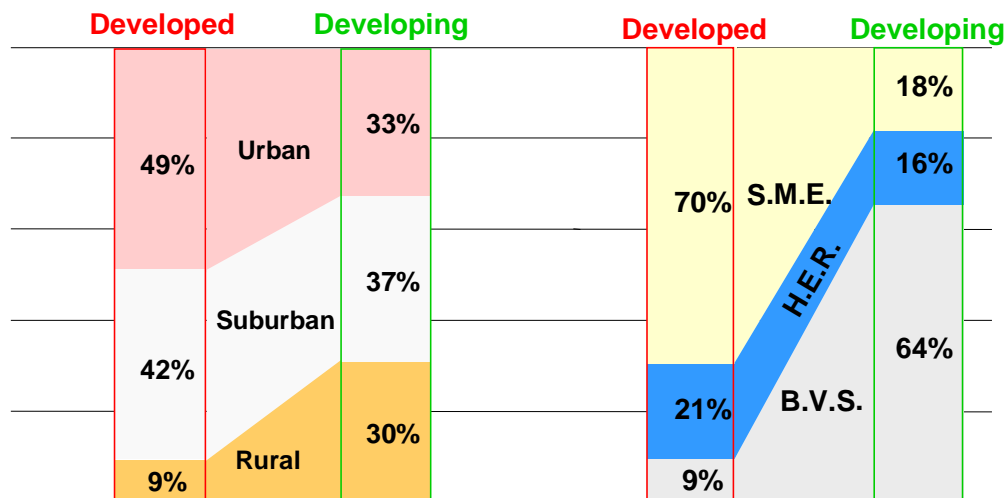


### Pay Phone & Public Calling Office

- niche application
- operator revenue concept
- shared resources among poor
- specialized application & features



## Subscriber Mix by Segment ('99-'04)



# Distribution of WLL Deployments

## Operator Focus Driven By Business Case, Regulations

|                           | <u>DEVELOPED</u> |          |       |
|---------------------------|------------------|----------|-------|
|                           | Urban            | Suburban | Rural |
| Basic Voice Services      |                  |          | 5 %   |
| High End Residential      |                  | 28 %     |       |
| Small, Medium Enterprises |                  |          |       |

- High teledensity levels
- Licenses awarded to promote competition
- Deployments purely profit driven

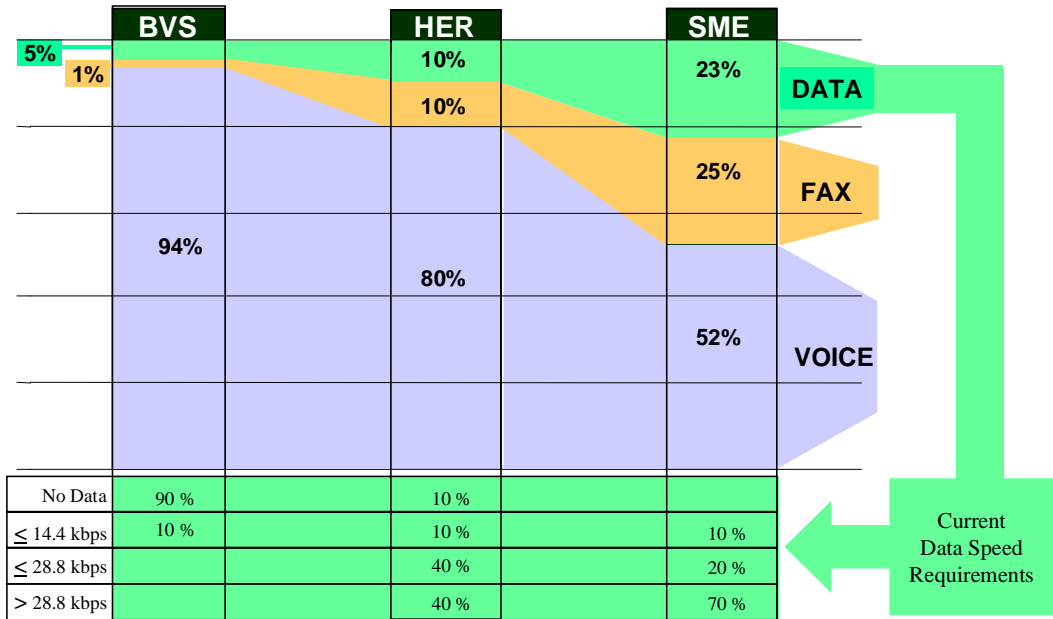
X% = segment's % of worldwide 5 yr subscriber TAM

|                           | <u>DEVELOPING</u> |          |       |
|---------------------------|-------------------|----------|-------|
|                           | Urban             | Suburban | Rural |
| Basic Voice Services      |                   |          |       |
| High End Residential      |                   | 65 %     |       |
| Small, Medium Enterprises |                   |          | 2 %   |

- Low teledensity levels
- Licenses awarded to increase teledensity
- Licenses mandate rural service deployment
- Major rural only opportunities with PTTs
- Mixed opportunities with CLECs
- 80% of operator rev. in HER & SME segments



## End-User Segment Traffic By Service Type



## Dominant Terrestrial WLL Technologies

- Cordless
- Fixed Wireless Access
- Cellular



## Cordless WLL Solutions

- TDMA/TDD formats use 5-20 Mhz between 1.88-1.93GHz
- Includes DECT, PHS, PACS, etc
- Evolved from wireless PBX/neighborhood cordless solutions
- **Benefits:** moderately priced subscriber/base equipment  
wide range of suppliers  
mature, digitally based technology  
provides mobility
- **Weakness:** small cell footprints (100m to 8km)  
interoperability between vendors not guaranteed  
ambivalent feedback from operators  
high annual operating & maintenance costs
- Not used or being pursued for WLL in the US (uPCS @ 1910-1930 MHz)
- Motorola involved early in the development of PACS



## Fixed Wireless Access WLL Solutions

- TDMA/FDD broadband formats using bands between 2-28 GHz
- Includes primarily proprietary point-to-point and point-to-multi-point Solutions.
- Evolved from microwave and cellular based technologies.
- **Benefits:** high capacity data & relatively fast data speeds  
good voice quality  
wireline transparency/PBX features
- **Weakness:** very expensive subscriber equipment  
reliance on external, line-of-sight antennas  
lack of vendor interoperability & interface standards  
small cell footprints requires high end-user teledensity
- A few US CLECs in urban markets are targeting high-end commercial segments that have high capacity data traffic requirements with these solutions, such as banks and professional services.



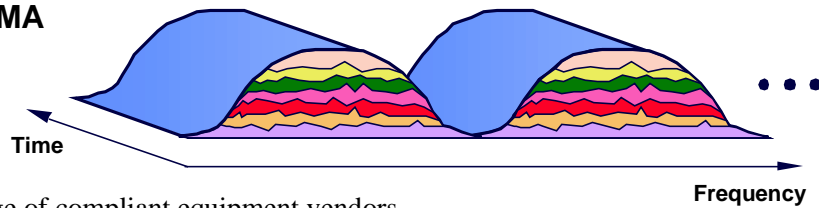
## Cellular WLL Solutions

- TDMA or CDMA, FDD formats use 800, 900, 1800 or 1900 MHz Bands
- Includes 2nd generation technologies, such as cdmaOne (IS-95), GSM, IS-136, iDEN, etc
- Evolved from 1st generation cellular technologies, such as AMPS, NAMPS, TACS, etc.
- **Benefits:** highly scaleable in capacity, coverage and features  
low annual operating and maintenance per unit  
large footprint coverage for rural markets  
mature, digital technologies with vendor interoperability
- **Weakness:** data speeds lag behind fixed wireless access technologies  
wireline transparency features vary between vendors
- US cellular operators in trials with WLL, targeting residential segments



## Why WASD Prefers cdmaOne™ For It's WiLL® Technology

### DS - CDMA

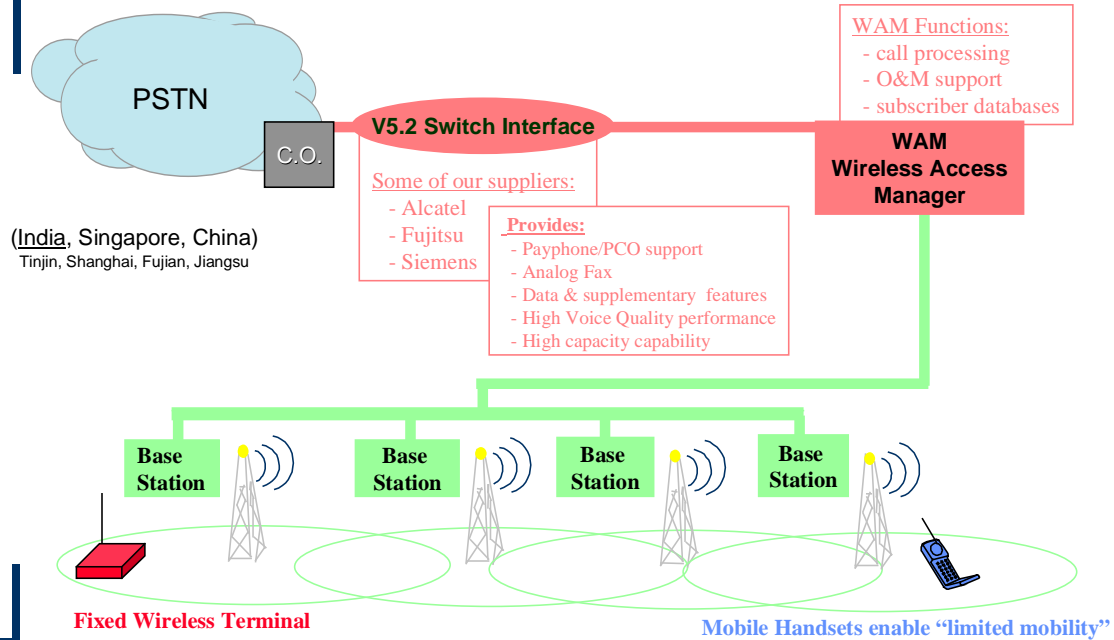


- Wide range of compliant equipment vendors
- Scaleable in cost, capacity & coverage
- Noted for it's voice quality throughout the industry
- Provides highly desired end-user services
  - security, privacy & encryption
  - calling features like caller ID, voice mail, etc.
- Roadmap to enhanced performance
  - 64 kbps data (near term)
  - additional capacity with IS-95 “B” & “C”



# Motorola WiLL® Solutions

(cdmaOne Systems at 800 MHz, 1900 MHz)



# Broad CDMA BTS Product Line

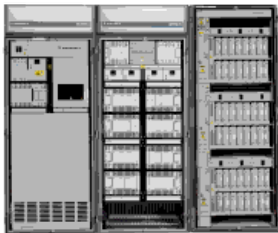


## SC™604

- Compact Self-Contained Outdoor BTS
- Built-in RF Components
- Quiet Convection Cooling To 50°C

## SC9600/2400

- High Capacity, Mixed CDMA/Analog
- Multi-Carrier LPA

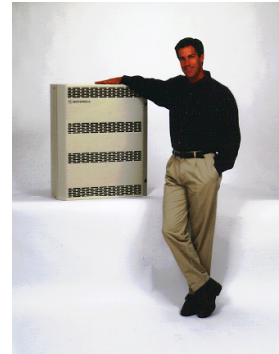


## SC™2450 / SC™4852

- High Capacity, High Density CDMA
- Efficient STLPA Design

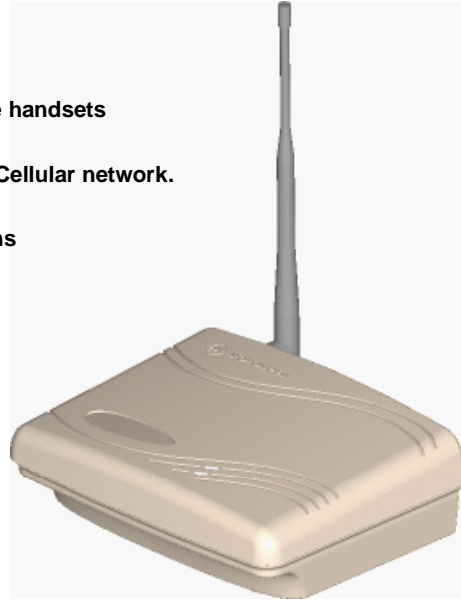
## SC601

- The First CDMA MicroCell
- 5W Power, Quiet Convection Cooling
- In-Building, In-Fill, Underground Uses
- Ideal For WiLL® Village Applications

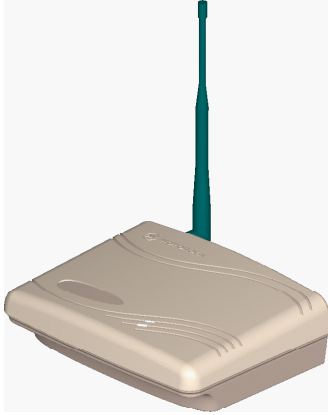


## What's an "FWT"?

- Our term for "End User or Subscriber Equipment"
- Connects to operator/end-user supplied telephone handsets
- Provides a Virtual 2-wire loop connection via the Cellular network.
- FWT RJ-12 Jack Provides Central Office Functions
  - | Loop start .
  - | Ringer Voltages.
  - | DTMF or Pulse Dialing.
  - | Local Dialtone & Digit Collection.
  - | Multiple phone extensions.
  - | Local or 100m remote.
- Internal Battery Backed up Power Source.
- Omni-Directional or Directional Antenna options.



## cdmaOne™ Lowers Install/Operating Costs Via Wide Scale Omni -Directional Antenna Use



### Cost factors:

|                    | <u>Omni-Directional:</u> | <u>Directional*</u> |
|--------------------|--------------------------|---------------------|
| Antenna            | \$8                      | \$65 - \$225        |
| Cabling, etc.      | none                     | \$35 - \$250 †      |
| Installation time  | 20 m                     | 120 m               |
| Annual Maintenance | none                     | yes                 |

### Distribution factors:

|                          |     |     |
|--------------------------|-----|-----|
| Retail/indirect channels | yes | no  |
| Consumer installation    | yes | no  |
| Technician installation  | yes | yes |

\* Approximate prices for volume sales

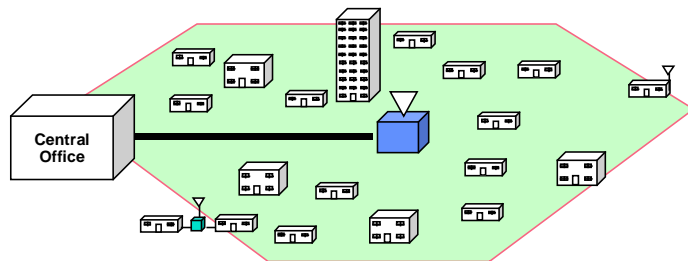
† Does not include mast, grounding, or lightning protection



# cdmaOne™ Coverage Capabilities Enable “Macro-Cell” Implementations

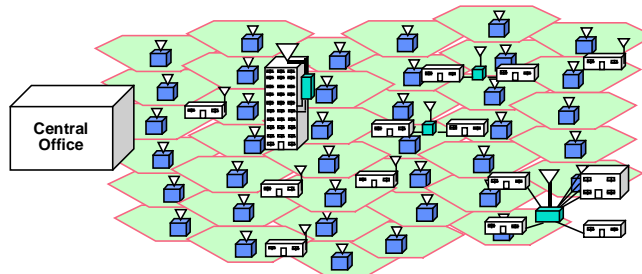
## Macrocell WLL

- Minimal use of Directional Antennas
- Lower monthly site rental and back-haul cost

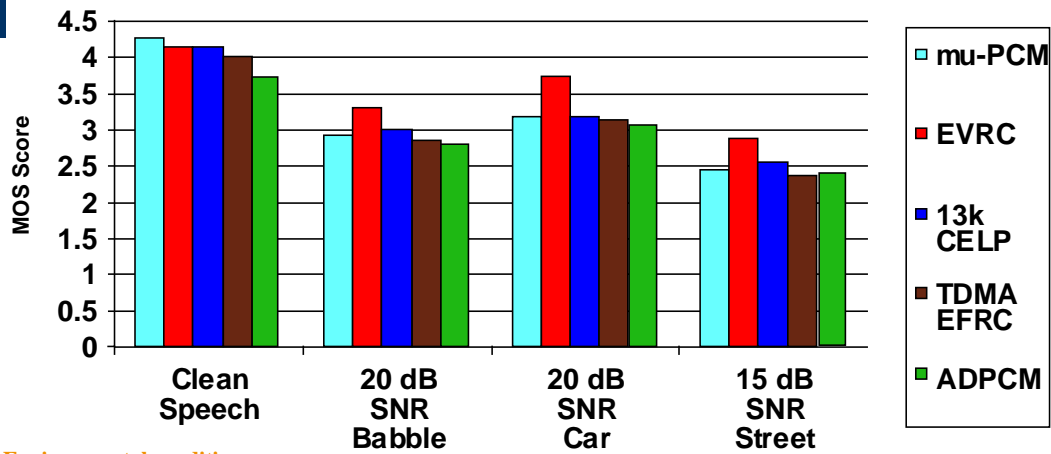


## Microcell WLL

- Extensive use of Directional Antennas
- Higher monthly site rental and back-haul cost



## cdmaOne™ is Noted Throughout the Wireless Industry For Voice Quality



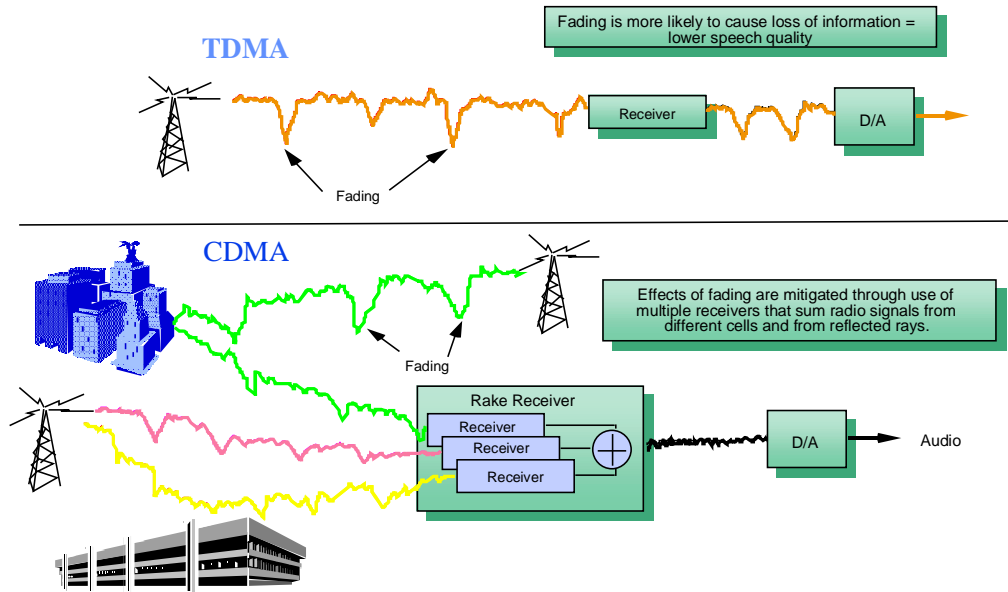
Environmental conditions

Note: MOS are the result of comparison tests, as such it is difficult to compare results from different testing sessions in a meaningful way.

Source: March 1996 Submission to CDG



## cdmaOne™ Path Diversity Is A Factor In Providing Excellent Voice Quality



# WASD Agenda

- WASD
  - Motorola Provider of WLL Solutions
  - Promoting “WiLL®” for at least 6 years
  - Historically pursued cellular based WLL solutions
- Worldwide WLL Background (5m)
  - Market Size
  - Motorola’s Involvement via “WiLL®”
- Requirements & Solutions (20m)
  - User/Application Segments
  - Popular WLL Technologies
  - Advantages of cdmaOne™ for WLL®
- Observations for US/Territories (5m)
  - **Barriers**
  - **Enablers**



## Barriers to WLL Deployment in Rural & Depressed Markets

- In US, the business case drives deployment
  - competitive wireless market environment
  - operators are CLECs, not PTTs
  - profit driven, pursuing available business with highest margins
- Business case drivers
  - potential end-user density (number of homes/business per sq. km)
  - required call models, services & usage patterns
  - financial considerations related to the end-user segments



## Some Market Enablers

- **Cellular technologies currently cover most of the US & territories**
- **Provide financial incentives that stimulate operator interest in Rural/Depressed Market WLL Businesses:**
  - Rebates on spectrum auction fees, or “No Cost” WLL Spectrum
  - Tax credits or grants for costs associated with servicing targeted users and areas
  - Equipment and/or Service cost subsidies for qualified users
- **Universal Service Mandates specifying WLL penetration & schedules on new spectrum allocations**



## **IDEN® SOLUTIONS FOR NATIVE AMERICANS<sup>2</sup>**

This section addresses how Motorola's iDEN technology provides unmatched functionality for wireless dispatch and interconnect services. iDEN fully integrates the following modes of operation: high quality digital telephone service, dispatch/net broadcast, alphanumeric messaging, and circuit switched and packet data. These premium features are incorporated into one network, providing users the full advantages of advanced wireless technologies using a single pocket-sized handset. Building on the success of the current platform, Motorola is developing a small digital wireless dispatch and interconnect system that borrows from the proven iDEN technology system to meet customer requirements for a more limited capacity and functionality than our existing iDEN system. Such a system may be appropriate to serve the needs of the Native American community.

### **iDEN Communications System Description**

#### **A. Introduction**

The state-of-the-art, digital iDEN system may serve as one of the ways to meet the wireless telecommunications requirements of the Native American community living on reservations and trust lands. Motorola's Land Mobile Products Sector first introduced the iDEN technology in 1994 as the integrated digital wireless solution designed for mobile workgroup applications in a variety of vertical markets. The functionality provided by iDEN fully integrates high quality digital telephone service, dispatch/net

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<sup>2</sup> Slides associated with this discussion are attached to this presentation.

broadcast mode, alphanumeric messaging, circuit switched and packet data, into one network giving users full advantage of advanced wireless technologies using one pocket-sized handset. iDEN systems currently operate in the 800 MHz bands worldwide, as well as in the 1.5 GHz band in Japan.

Using a cellular design approach, iDEN integrated digital wireless systems are designed to meet the high capacity needs of operators worldwide, and are most cost efficient in large user markets having greater than 20,000 subscribers. Motorola has conducted market research and product development analyses to respond to the needs of customers who have start-up or smaller market areas. These customers are requesting lower priced systems designed for less than 5,000 subscribers while providing core interconnect and dispatch capabilities, plus the ability to use similar subscriber handsets as do the larger market operators. To meet this demand, Motorola is developing a small digital wireless dispatch and interconnect system MSO (Mobile Switching Office). Motorola believes that this small-scale configuration could be able to meet the wireless telecommunications requirements of the Native American community.

The following is a brief descriptions of iDEN digital technology, the new small digital wireless dispatch and interconnect MSO backbone technology, and the features and services provided by the subscriber units for use in the system.

#### **B. iDEN Digital Technology**

A variety of proven RF technologies have been enhanced and incorporated into iDEN's advanced digital architecture to gain the increased capacity necessary to support a fully optimized, wireless digital network. The development of this spectrally efficient

technology allows multiple communications to occur over a single analog channel. This expansion of the network gives users greater access to the network and provides space for new and expanded services to be added without rebuilding the infrastructure. This increased capacity is due to a combination of three technologies: the VSELP (Vector Sum Excited Linear Predictors) voice coding (“vocoding”) technique, the M16QAM (quadrature amplitude modulation) modulation process, and the TDMA (Time Division Multiple Access) channel splitting process.

- *VSELP Coding Signals:* The driving force behind the expanded capacity of iDEN is the reduced transmission rate needed to send information. Motorola has developed a vocoder technology that compresses voice signals into digital packets of information that are time assigned, transmitted and received on the iDEN network. This vocoder, known as VSELP, compresses the voice signals to reduce the transmission rate needed to send information. In addition, VSELP provides for clear voice transmission by digitizing the voice's essential elements, thus providing high quality audio under conditions that might have distorted analog voice. If a speech segment gets lost over the radio channel, the VSELP decoder can "repair" the effect through speech extrapolation. The result is less distortion and interference as users move toward fringe coverage areas, enhancing the clarity and quality of iDEN's voice communications.
- *M16QAM Modulation:* While the VSELP compresses the signal and reduces the transmission rate, the M16QAM Modulation increases the density of the information. Modulation is the process of adding information to the radio wave that alters parameters of the radio wave to represent the information content of the signal. More advanced modulation techniques like M16QAM increase the density of the information put on the signal. M16QAM technology was specifically designed to support the digital requirements of the iDEN network. The technology transmits information at a 64 kilobit-per-second rate. Higher transmission rates mean squeezing more information onto existing channels, resulting in increased spectral capacity. This modulation technology allows for extremely efficient transmission in a 25 kHz channel.
- *Time Division Multiple Access (TDMA):* This is a technique for dividing the radio channel into multiple communications pathways. During transmission, voice and data are divided into packets. Each packet is assigned a time frame and transmitted over the airwaves. At the receiving end, the packets are reassembled according to their assignments into the original information sequence. In the iDEN system, each 25 kHz radio channel is divided into six distinct communications pathways creating a 6:1 ratio with utilization of a four kilobit vocoder for encoding and decoding voice. This 6:1 rate is used for one-to-one and one-to-many dispatch/net broadcast communications (referred to commercially as private call and group call). To improve

the overall audio quality, tone, and richness of telephone interconnect communications, even in weak signal and interference areas, iDEN combines two 6:1 slots to create a 3:1 equivalent slot for the telephone interconnect mode. This 3:1 ratio allows the use of an eight-kilobit vocoder and advanced forward correction protocols that correct many corrupted bits of data information sent over the airwaves, while still delivering efficient use of the RF spectrum.

### **C. Motorola Small Digital Wireless Dispatch and Interconnect System MSO**

The small digital wireless dispatch and interconnect system MSO (Mobile Switching Office) is a commercial-off-the-shelf system designed to incorporate proven iDEN technology and selected commercial iDEN subscriber units. It will eventually be fully interoperable with commercial service provider iDEN-based systems and permits migration to a full-sized iDEN infrastructure for those commercial service providers who require a smaller, yet full featured system, until their market grows into the over 20,000 subscriber size.

For the Native American reservations installation, a single MSO equipped with a single site supporting 4 channels should handle the requirements. The system architecture includes a *system* controller with management console to handle all interconnect, packet duplication, packet switching, transcoding, and network management functions. Also included is a Dispatch Application Processor (DAP) to handle all dispatch calling activity, and a single cell site with four base radios. The MSO features a compact design with T1 digital connectivity to the cell site and the public switched telephone network (PSTN). This architecture allows for up to 4 additional base radios to be connected to the cell site and the addition of up to 7 additional cell sites (up to eight sites) under the control of a single MSO.

The small wireless platform is designed to meet commercial provider requirements for limited capacity and functionality. This is currently defined to include

two-way dispatch and telephone interconnect. Circuit switched and packet data functionality will be considered for possible future capability, but are not currently planned for inclusion in the system. Proposed dispatch features for the system include the support for a dispatch-only mode, support up to 1000 fleets (average of 5 users per fleet), and support up to 3000 talkgroups. The system would operate in the 806-821 MHz transmit and 851-866 MHz receive frequency bands.

#### **D. iDEN Subscriber Radios**

iDEN subscriber radios are available in a number of digital handset platforms that offer an expanded feature set with user-customized options in various size and feature configurations for use in the small digital wireless dispatch and interconnect system. Not all of these functions and features may be needed to serve the wireless telecommunications requirements of the Native American community.

The iDEN i1000 is a fourth generation digital handset that includes integrated telephone interconnect and two-way radio functions. Dispatch or net broadcast mode provides digital, two-way trunked dispatch radio functionality in half-duplex mode, and includes the following features:

- *Group call (one-to-many)*- The ability to reach a predefined group of people via a one touch group call (push-to-talk) button.
- *Private call (one-to-one)*- The ability to select and talk privately and directly to a particular individual via the same push-to-talk button.
- *Call alerts*- The ability to send a page from one radio to another without accessing the PSTN telephone system or a separate paging system.

Digital telephone service provides cellular telephone, full duplex mode of operation.

## iDEN® SOLUTIONS FOR NATIVE AMERICANS: SLIDES

### "Small digital wireless platform" - Background

- iDEN® system is used worldwide by CMRS operators to provide dispatch, telephone and data communications to a broad range of user communities including private and public enterprises, including non-essential public safety and government field offices
- "Small digital wireless platform" is an effort to extend the principal benefits of iDEN to third tier urban, rural and underserved markets.
- "Small digital wireless platform" product strategy is centered on making the start-up costs low enough to enable positive cash flow by the third year of operation, enabling small operators to attractive the necessary financing
- "Small digital wireless platform" systems can remain small or be migrated with minimal retirement of initial equipment to standard iDEN systems



## "Small digital wireless platform" - Opportunities

- Emerging Growth Markets
  - Less than 5K subscribers within 2-3 years
- Small, Localized Markets
  - Market size not expected to exceed 5K subscribers
- E1/T1 Backhaul Cost Dependence Avoidance
- Regulatory Requirements
  - Remote Coverage Requirements
  - Frequency Allocation Process
- Technology Benefits
  - 5X Subscribers per Channel
  - Easy Migration to Larger systems
  - Interworking ("Roaming") with Larger Standard iDEN systems



## "Small digital wireless platform" - Challenges

- Consolidation of Many Platforms into Few
  - Today's standard iDEN system has over 8 separate platforms
  - "Small digital wireless platform" consolidates major functions into 2 platforms
- Scalable Pricing Structure
  - "Small digital wireless platform" pricing tied to actual number of end users
- Ongoing Operations Expense
  - "Small digital wireless platform" designed to require minimal installation and operations effort
- System Growth / Migration
  - "Small digital wireless platform" solution allows 80% - 85% of initial investment to be retained
- Participation with Nationwide Mobile Telecommunications Systems
  - "Small digital wireless platform" needs an optional capability for "seamless roaming"
- Regulatory Compliance
  - "Small digital wireless platform" needs a solution to complex problem of digital wiretap



## "Small digital wireless platform" - Summary

- *"Small digital wireless platform"* is ...  
Leading State-of-the-Art Digital Technology
- *"Small digital wireless platform"* is ...  
An Ideal Solution for New & Small Market System Deployments
- *"Small digital wireless platform"* introduces ...  
A New Compact iDEN Architecture
- *"Small digital wireless platform"* uses ...  
Proven iDEN Protocol Site Equipment and Handsets
- *"Small digital wireless platform"* is...  
Competitively Priced enabling Carriers to get started at minimal cost
- *"Small digital wireless platform"* offers ...  
Digital Dispatch, Interconnect and Short Messaging Functionality
- *"Small digital wireless platform"* offers ...  
Reuse of Sites and Handsets in a standard iDEN network



## **IRIDIUM® SATELLITE SERVICES FOR NATIVE AMERICANS<sup>3</sup>**

The Iridium satellite system is a low earth orbit constellation of 66 operational satellites that are interconnected with each other and with 11 or more terrestrial ground station gateways distributed around the world. As shown in the attached slide, the Iridium System combines the worldwide reach of the LEO satellites with additional access to multiple wireless systems and standards. The Iridium system permits telephone transmission-voice, paging, data and fax (not currently available) to reach its destination virtually anywhere on Earth. The Iridium portfolio can facilitate communications for residents of rural or underdeveloped areas, disaster relief teams and others.

Iridium North America is the sole owner and operator of the North American gateway providing Iridium services in the United States, Bermuda Canada, Guam, and Puerto Rico. Gateway operators establish and manage relationships with services providers and terrestrial wireless network operators. The service provider is responsible for Iridium subscriber acquisition, billing and customer care. The terrestrial wireless network operator provides local terrestrial wireless network access to Iridium subscribers and whose customers may access the Iridium system as a feature for roaming onto other terrestrial wireless networks or the Iridium satellite system.

### **Subscriber Equipment**

Iridium service may be delivered over a variety of subscriber terminals:

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<sup>3</sup> This section was prepared by Iridium U.S., L.P. d/b/a Iridium North America. 1999 Iridium and the Iridium logo are registered trademarks and service marks of Iridium LLC.

- satellite wireless-only subscriber equipment
- satellite/terrestrial handheld wireless subscriber equipment
- terrestrial wireless-only subscriber equipment
- satellite message termination devices (MTD) also known as pagers.

The handheld satellite wireless units allow for operation over the Iridium satellite system. These units take full advantage of the Iridium networking capability to deliver a call or message over the Iridium satellite system.

The handheld satellite/terrestrial wireless units allow for operation over the Iridium satellite system and over a compatible terrestrial wireless network. These units take full advantage of the Iridium networking capability to deliver a call or message over the best available network whether it is a compatible terrestrial network or the Iridium satellite system. The satellite function serves those subscribers who are outside cellular coverage.

If no satellite coverage is required, terrestrial wireless-only equipment may be used. The terrestrial wireless unit must be compatible with a particular cellular network that has coverage in the area and is programmed to identify the user as an Iridium customer.

Satellite message termination devices (MTD) support virtually all of the features of a premium terrestrial simplex alphanumeric paging device.

In addition to the subscriber equipment listed above, the subscriber must use a Subscriber Identification Module (SIM) card to access the Iridium system. The SIM card is the size of a credit card or processing chip and contains the subscriber information for usage and billing purposes.

## **The NOMAD Program – Iridium Assistance for Developing Countries**

During the World Telecommunications Policy Forum meetings in Geneva in October 1996 (WTPF-96), there was an international interest in having Iridium and other GMPCS providers allow access to their systems in an equitable way regarding developing nations so such countries may extend their existing telecommunications infrastructure. WTPF-96 Opinion 5 urges “GMPCS system providers [to] consider providing some capacity at reasonable cost in support of service provision to areas lacking conventional infrastructure in developing countries.”

To this end, Iridium LLC (“ILLC”) has developed NOMAD, a program whose three component parts comprise a partnership for better telecommunications service between ILLC, its gateway investor groups and the participating countries. NOMAD will be available to 187 countries with per capita GNP of less than \$9,386, based on information provided by the World Bank. NOMAD services will provide interested governments Iridium satellite phones and domestic usage at a significant discount and includes free phones for use in emergencies.

Although the United States does not qualify as a developing country, ILLC and Iridium North America would work together to offer the most effective solution for the subscriber at a competitive price.

### **Potential Solutions and Issues**

Iridium North America provides Iridium service to subscribers along with its service providers and terrestrial wireless network operators. Iridium North America

works with its providers to offer the most effective solution for the subscriber at a competitive price. Native Americans living on reservations or trust land are potential subscribers that could benefit from the coverage and flexibility the Iridium system offers.

The single largest issue facing the tribal governments is funding. As a new and unique technology, the Iridium satellite system infrastructure is in place. No additional ground facilities are required to access the Iridium services. However, subscribers access the Iridium satellite service by purchasing or leasing subscriber equipment and bear service usage costs for minutes used.

Iridium North America is open to working with the tribal governments on solutions that it and its service providers and terrestrial wireless network operators can provide to the Native America citizens in their communities. A combination of Iridium subscriber equipment and service may provide the communities with the telecommunications they require. One potential use is to placing the equipment at strategic points in the community where telecommunication services are necessary (e.g. police and security personnel) and provide individuals with SIM cards that can be used as needed. A closer look at the NOMAD program and how it may be modified and implemented in these communities is another potential solution.

To provide potential solutions such as this would require allowances to support the costs associated with providing the Iridium subscriber equipment and service minute usage. In providing such solutions to Native American communities, the Universal Service would be a potential source of support. Other governmental assistance could be provided such as grants or subsidies specifically aligned with providing service and equipment to these communities. Just as telecommunication providers must be creative

and work with the tribal governments to meet their citizens' needs, the regulatory bodies can be equally creative so that all parties achieve the goals of serving these rural communities.

## **IRIDIUM® SATELLITE SERVICES FOR NATIVE AMERICANS: SLIDES**

